

- The rules for this event have been adapted for our virtual tournament and follow the **2020-2021 Regional Rules**.
- For fill-in-the-blank questions, the capitalization of the answers (e.g. Answer vs. answer) will **NOT** be considered (i.e., both answers will be accepted). However, incorrect spelling and unnecessary spaces before/after the answers will lead to an incorrect answer. Keep this in mind!
- For multiple-choice questions with multiple answers, it's ALL or NOTHING - *there's no partial credit!*
- The maximum number of obtainable points on this exam is **126**.
- Leaving the test window is **NOT** acceptable - time outside the browser *will* be monitored by Scilympiad!!
- If you have any questions or concerns regarding this exam, feel free to contact me through the following email once the testing window has concluded: shrayenpatel@utexas.edu
- Exam Author: Shraven Patel, *The University of Texas at Austin, B.S. Biology '24*
- Per Texas Science Olympiad rules, you must have printed notes for this event. If you are communicating with your partner through a voice or video call, please start it before you begin the test itself.
- Significant time spent outside of the browser window is grounds for a penalty or disqualification per TSO policies.

1. (1.00 pts) Community water \_\_\_\_\_ prevents tooth decay both effectively & safely!

fluoridation

2. (1.00 pts) Direct potable water reuse involves some sort of environmental buffer (ex. river) prior to water treatment.

True  False

3. (1.00 pts) National Primary Drinking Water Regulations undergo review every \_\_\_ years. (**enter an integer ONLY**)

6

4. (4.00 pts) According to the EPA, which of the following processes accomplish the water treatment objective of removing suspended solids?

(Mark **ALL** correct answers)

- A) Coagulation
- B) Flocculation
- C) Sedimentation
- D) Electrodialysis
- E) Ultraviolet Disinfection
- F) Microfiltration

5. (4.00 pts) According to the EPA, which of the following processes accomplish the water treatment objective of disinfecting & removing trace organic compounds?

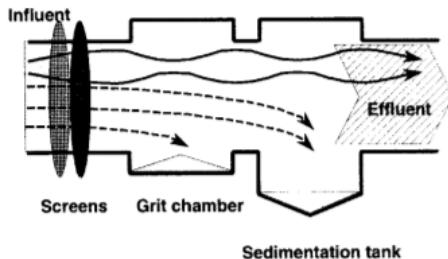
(Mark **ALL** correct answers)

- A) Sedimentation
- B) Ultrafiltration
- C) Reverse Osmosis
- D) Nanofiltration
- E) Ultraviolet Disinfection
- F) Pasteurization

6. (1.00 pts) Blending groundwater with surface water is a technique often used to improve water quality prior to treatment.

True  False

7. (1.00 pts) Which step of the wastewater treatment process is depicted in the diagram below?



- A) Primary  
 B) Secondary  
 C) Tertiary

8. (3.00 pts) Why are grit chambers especially important in water treatment networks in coastal regions, such as Florida and Hawaii?

**Expected Answer:** high levels of sand or gravel may wash into sewers alongside stormwater (all or nothing)

9. (1.00 pts) Chlorination can kill more than \_\_\_ % of harmful bacteria in a stream of effluent. (**enter an integer ONLY**)

99

10. (2.00 pts) How can wastewater be used to track COVID-19?

**Expected Answer:** poop, excretion, or effluent (1 pt for any) can be tested just like a nasal swab via PCR (1 pt)

11. (1.00 pts) A single severe event (ex. hurricane) can dramatically affect an estuary.

- True     False

12. (3.00 pts) Which of the following are TRUE regarding the importance of estuaries?

(Mark ALL correct answers)

- A) Humans widely use estuaries for recreational activities such as boating and fishing  
 B) Estuaries protect human communities against flooding and help mitigate storm surges  
 C) Wastewater treatment facilities play little to no impact on estuarine water quality  
 D) Estuaries are dynamic ecosystems that incorporate diverse habitats

13. (1.00 pts) Over \_\_\_ % of the world's coral reefs have died in the past 30 years. (**enter an integer ONLY**)

50

14. (3.00 pts) What are 2 modes of asexual coral reproduction?

**Expected Answer:** budding (1), fragmentation (1), 3rd point earned as a bonus if question entirely correct!

**15. (6.00 pts)** What are 2 modes of sexual coral reproduction? What is a major difference between the larvae produced from each of these two sexual reproductive methods?

**Expected Answer:** broadcast spawning (1), brooding (1), 3rd point earned as a bonus if points 1-2 both earned! brooding produces relatively big larvae that already contain zooxanthellae (1) whereas broadcast spawning produces larvae that generally take up their zooxanthellae shortly after settlement (1), 6th point earned as a bonus if points 4-5 both earned!

**16. (1.00 pts)** Most coral species are gonochoric.

True  False

**17. (1.00 pts)** Some beaches turn what color from gametes washed ashore after a night of coral spawning?

- A) Red
- B) Orange
- C) Yellow
- D) Green
- E) Blue
- F) Purple

**18. (1.00 pts)** A harmful algal bloom can look like foam on surfaces of water bodies when viewed from above.

True  False

**19. (3.00 pts)** Which of the following are toxins produced from harmful algal blooms?

(Mark ALL correct answers)

- A) Azaspiracid
- B) Bufotoxin
- C) Dioxin
- D) Domoic acid
- E) Saxitoxin
- F) Ricin

**20. (1.00 pts)** Harmful algal blooms are more likely to occur in rapid-moving water than slow-moving water, disregarding the other factors necessary for one to occur.

True  False

**21. (1.00 pts)** Dogs are more susceptible than humans to poisoning from a harmful algal bloom.

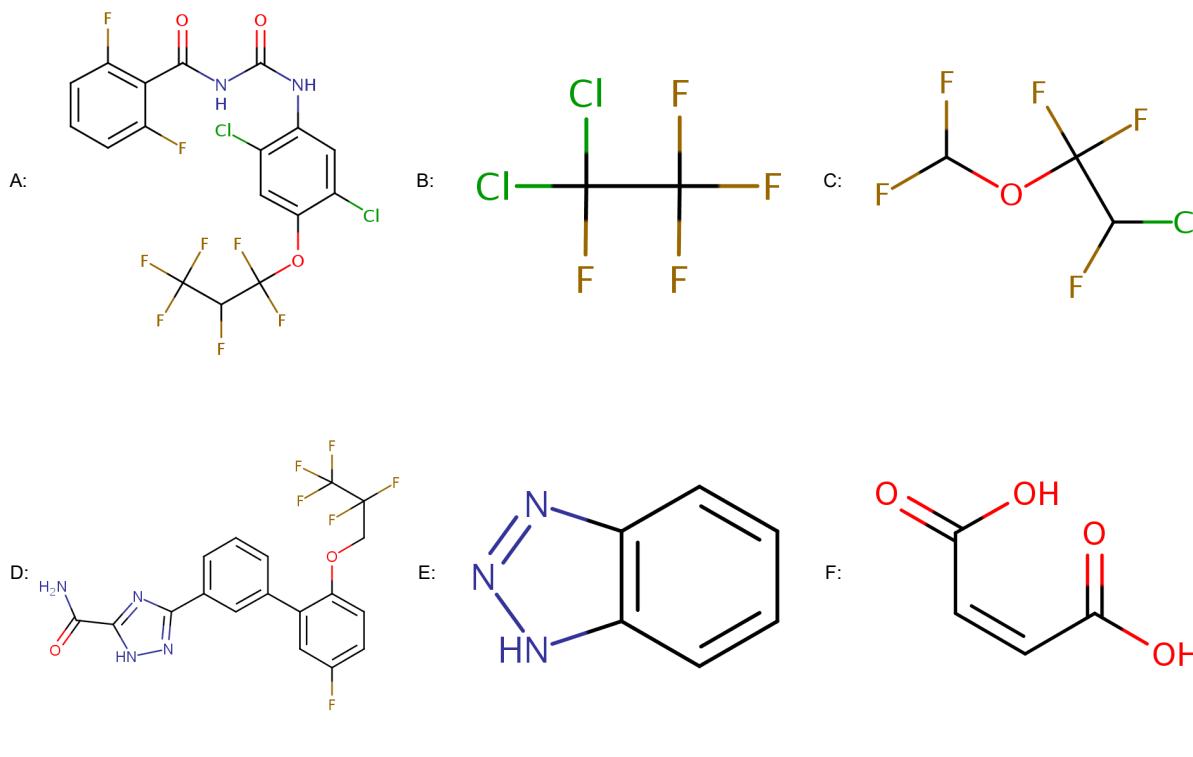
True  False

**22. (1.00 pts)** Which bond prevents per- and polyfluorinated alkyl (PFAS) chemicals from degrading in the environment?

- A) Carbon-hydrogen
- B) Carbon-chlorine
- C) Carbon-carbon
- D) Carbon-fluorine

23. (4.00 pts)

Based on their chemical structure as pictured below, which of the following are categorized as PFAS chemicals?



(Mark ALL correct answers)

- A) A
- B) B
- C) C
- D) D
- E) E
- F) F

24. (1.00 pts) PFAS chemicals repel oil and water.

- True
- False

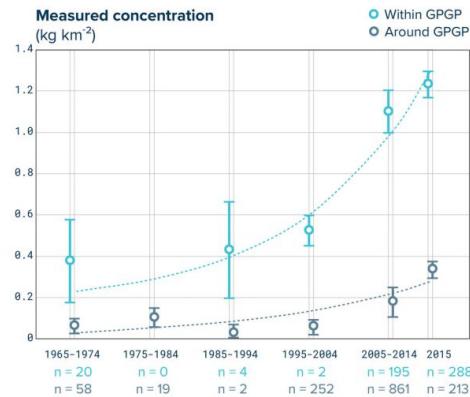
25. (1.00 pts) PFAS chemicals have relatively short half-lives.

- True
- False

26. (1.00 pts) Most of the "garbage" in the five ocean garbage patches consists of what?

- A) Fishing gear
- B) Water bottles
- C) Micro-plastics
- D) Bags
- E) Wrappers

27. (1.00 pts) Based on the diagram below, how has the concentration of waste in the Great Pacific Garbage Patch changed over time?



- A) Decreased
- B) Remained constant
- C) Increased

Use the following image for the next FIVE questions (28-32):



28. (1.00 pts) What is the common name of organism A? (enter exactly as printed in the rules manual, with NO spaces in between words if applicable)

grouper

29. (1.00 pts) Most members of organism A are \_\_\_\_\_ hermaphrodites.

protogynous

30. (1.00 pts) Members of organism A can grow up to \_\_\_ pounds. (enter an integer ONLY)

800

31. (1.00 pts) Members of organism A tend to live in groups with a ratio of about 4-14 females to 1 male.

- True
- False

32. (1.00 pts) Members of organism A cannot change skin color(s) to blend in with their environment.

- True
- False

Use the following image for the next SEVEN questions (33-39):



33. (1.00 pts) What is the common name of organism B?

- A) Banded coral shrimp
- B) Sponge
- C) Lobster
- D) Moray eel

34. (1.00 pts) Members of organism B have \_\_ sets of jaws. (enter an integer ONLY)

2

35. (1.00 pts) Referring back to the previous question, these specific jaws are called \_\_\_\_\_ jaws.

pharyngeal

36. (1.00 pts) Most members of organism B are diurnal.

- True
- False

37. (4.00 pts) Members of organism B have one apparent long, single, unbroken structure merging what three fins together?

**Expected Answer:** dorsal (1), caudal (1), anal (1) // +1 bonus if all three fins named correctly!

38. (1.00 pts) Members of organism B have strong night vision.

- True
- False

39. (1.00 pts) Members of organism B are currently listed as endangered on the IUCN Red List of Threatened Species.

- True
- False

Use the following image for the next SIX questions (40-45):



**40. (1.00 pts)** Organism C is a pencil urchin.

- True  False

**41. (2.00 pts)** Why are members of organism C vital to the health & survival of coral reefs?

**Expected Answer:** Eat algae (1) which can grow excessively on coral reefs, thus preventing overgrowth or algal blooms from occurring (1)

**42. (2.00 pts)** How do members of organism C ensure eggs and sperm are released in the water at the same time to facilitate reproduction?

**Expected Answer:** Male or female sea urchin secretes chemical into water (1) --> scent picked up by other sea urchins, leading to release of gametes into water (1)

**43. (1.00 pts)** Members of organism C are currently listed as endangered on the IUCN Red List of Threatened Species.

- True  False

**44. (1.00 pts)** At one point in history, almost 90% of members of organism C died off.

- True  False

**45. (1.00 pts)** The spines on members of organism C usually grow up to how many centimeters?

- A) 1-3
- B) 4-6
- C) 7-9
- D) 10-12
- E) 13-15
- F) 16-18

Use the following image for the next FOUR questions (46-49):



**46. (1.00 pts)** What is the common name of organism D? (enter exactly as printed in the rules manual, with NO spaces in between words if applicable)

triton

47. (2.00 pts) How do members of organism D prepare their prey for consumption?

Expected Answer: With acid saliva (1), it paralyzes prey and softens limestone skeleton to subsequently erode it (1)

48. (3.00 pts) Which of the following are preyed on by members of organism D?

(Mark ALL correct answers)

- A) Crown of thorns starfish
- B) Sea cucumbers
- C) Snappers
- D) Bumphead parrotfish
- E) Lobsters

49. (1.00 pts) Members of organism D are cold-water predators.

- True
- False

50. (10.00 pts)

For EACH organism from the 2020-2021 Water Quality species list pictured below, identify the organism and its common name (**example format: "M - Lobster"**). If an organism is NOT part of the 2020-2021 Water Quality species list, do NOT name it below, as negative points ARE possible for this question.

You may be asking yourself "why would he do this to us?!" and the answer is: to ensure you're actually able to distinguish between organisms and aren't just guessing from the given list!!

J:



K:



L:



M:



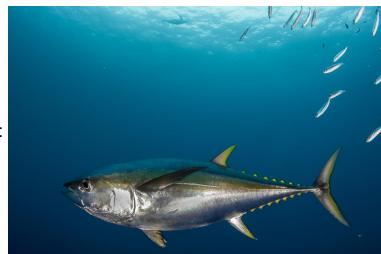
N:



O:



P:



Q:



R:



S:



**Expected Answer:** J - butterflyfish, K - butterflyfish, L - butterflyfish, O - parrotfish, Q - parrotfish, R - sweetlips // +1 for each correct answer, -1 for each incorrect answer, 0 pts if blank, +4 bonus if got all correct!

**51. (1.00 pts)** Temperature has the smallest impact of all analytes on the concentration of dissolved oxygen in a sample of water.

- True  False

**52. (5.00 pts)** Which of the following have a DIRECT relationship with each other?

(Mark ALL correct answers)

- A) Temperature & phosphates
- B) Temperature & nitrates
- C) Temperature & total dissolved solids
- D) Temperature & biological oxygen demand
- E) Temperature & dissolved oxygen
- F) Temperature & fecal coliform

**53. (1.00 pts)** Temperature and turbidity have an INVERSE relationship with each other.

- True  False

**54. (1.00 pts)** Temperature and pH have an INVERSE relationship with each other.

- True  False

**55. (1.00 pts)** Sediment is the largest point source pollutant in the United States.

- True  False

**56. (1.00 pts)** A conductivity test is the most accurate test to determine the level of total dissolved solids (TDS) in a sample of water.

- True  False

**57. (1.00 pts)** If the Secchi depth measured is 3 meters, the range of approximate depth that light can penetrate into the body of water is also 3 meters.

- True  False

**58. (1.00 pts)** The scattering light method of detecting turbidity is used for samples of water with an apparent high turbidity.

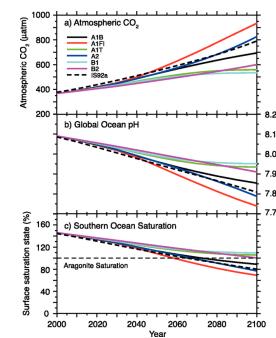
59. (10.00 pts) What is/are the difference(s) between the membrane filtration method and multiple-tube fermentation methods of testing for fecal coliform bacteria?

**Expected Answer:** Membrane filtration method involves filtering several different-sized portions of sample using filters with standard diameter and pore size, placing each filter on selective nutrient medium in petri plate, incubating plates at specified temperature for specified time period, and then counting colonies that have grown on filter; varies for different bacteria types (variation examples: nutrient medium type, number and types of incubations, etc.). // 4 points // Multiple-tube fermentation method involves adding specified quantities of sample to tubes containing nutrient broth, incubating tubes at specified temperature for specified time period, and then looking for development of gas and/or turbidity that bacteria produce; presence or absence of gas in each tube used to calculate index known as Most Probable Number (MPN). // 4 points // +2 bonus for DETAILED, VALID description of BOTH methods

60. (1.00 pts) An aragonite saturation level greater than \_\_\_ indicates supersaturation. (enter an integer ONLY)

1

61. (5.00 pts) Based on the diagram below, what is the relationship between carbon dioxide levels and aragonite saturation levels? Explain why.



**Expected Answer:** Inverse (1) - when carbon dioxide is added to surface seawater, acidity of surface seawater increases (1) --> if surface acidity increases, there is relatively less carbonate ion ( $\text{CO}_3^{2-}$ ) in seawater (1), thus value of  $\Omega$  decreases and so does saturation state of seawater with respect to aragonite (1) // +1 bonus point if earned the other 4 for this question

62. (1.00 pts) A \_\_\_\_\_ measures the concentration of salt in a solution.

salinometer

63. (1.00 pts) A \_\_\_\_\_ measures the specific gravity of a sample of water.

hydrometer

64. (1.00 pts) The standard oxidation/incubation test period for biological oxygen demand (BOD) is 5 days at 20 degrees Celsius ( $^{\circ}\text{C}$ ).

65. (1.00 pts) If a sample of water is NOT diluted, its biological oxygen demand (BOD) can be calculated by subtracting its initial dissolved oxygen (DO) level from its final DO level.

**66. (1.00 pts)**

To ensure proper biological activity during a BOD test, a sample of water must not contain any \_\_\_\_\_. (enter the full name of ONE element from the periodic table)

chlorine

**67. (1.00 pts)** Limestone is a source of natural alkalinity.

- True  False

**68. (1.00 pts)** The hardness of a sample of water depends on the level(s) of which of the following elements in the sample?

- A) Calcium  
 B) Magnesium  
 C) Both A & B  
 D) Neither A & B

**69. (1.00 pts)** On average, Utah has "harder" water than Alabama.

- True  False

Congratulations, you've completed the 2021 UT Austin Regional Water Quality B/C test! Best of luck in your other events, and I hope you enjoyed taking this test today! If you have any feedback about any of the exams at this tournament, please let us know through this form: <https://tinyurl.com/utreg21feedback> (<https://tinyurl.com/utreg21feedback>)

- Shraven Patel (UT '24)